Jet Propulsion Laboratory
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Enhanced Autonav for Mars 2020 Rover: Introduction

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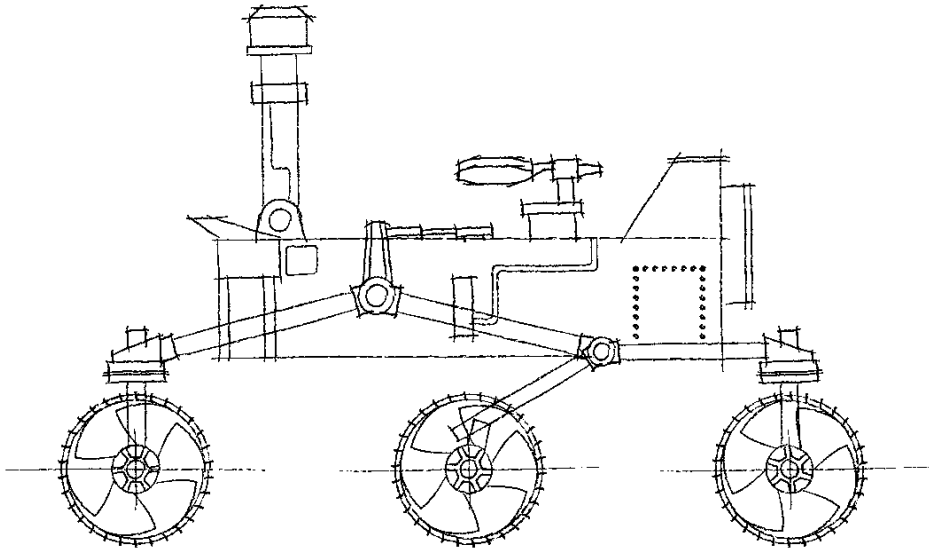

Mars 2020 Project

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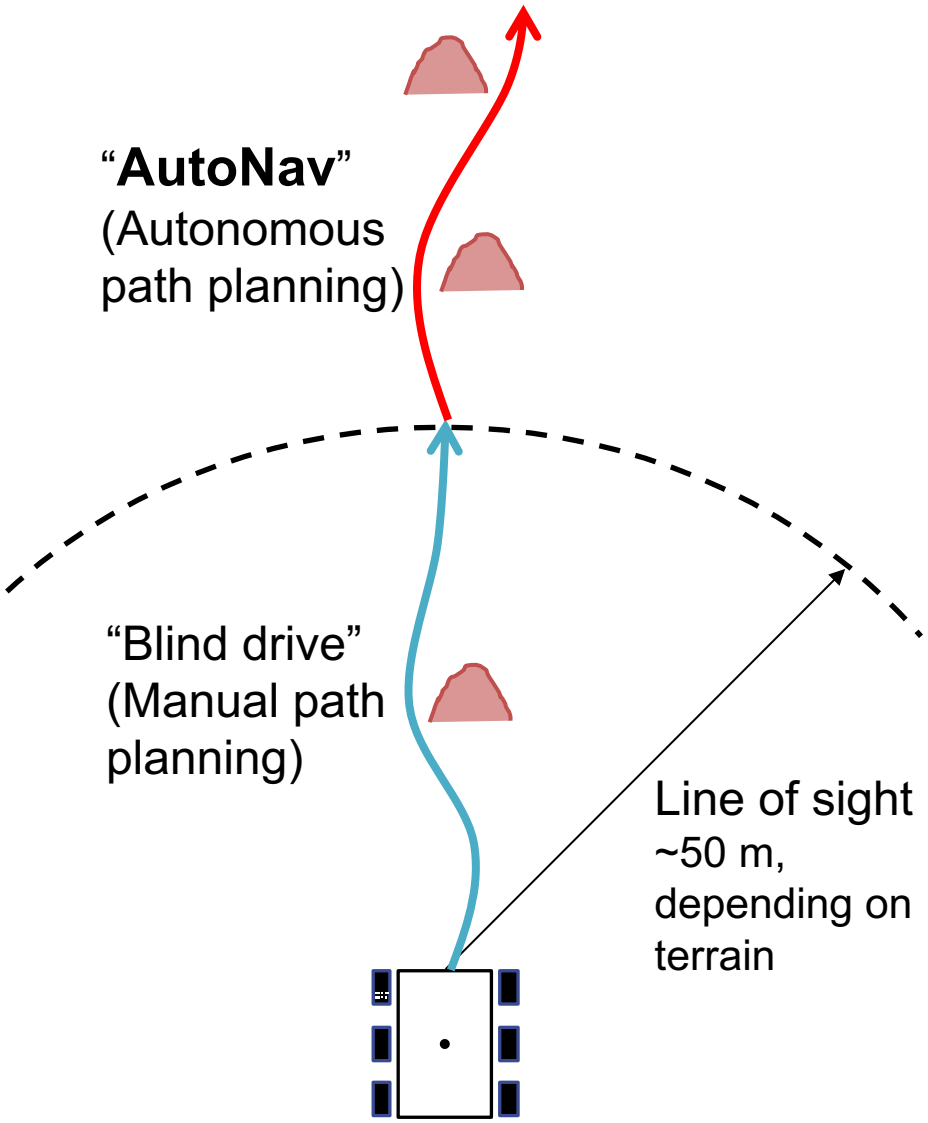
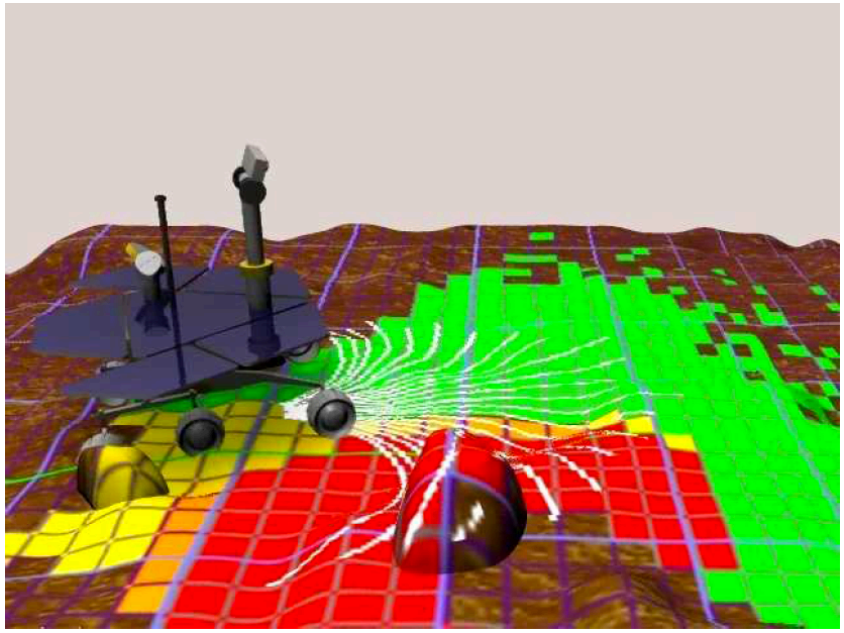
Why Autonav?



- Manual path planning is limited within the line of sight
- Up/down link: once per Sol (Martian day = 24hr40min)
- AutoNav extends drive distance per Sol beyond the line of sight
- AutoNav successfully drove on MER/MSL rovers



Why AutoNav enhancement is needed for the Mars 2020 Rover?

Enable autonomous driving on more complex terrain for a longer distance with increased reliability

Blind drive (~50 m) | Autonav

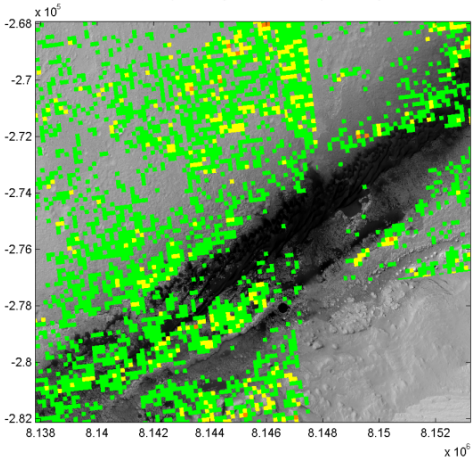
2020/SRL concept

150-200m/sol *on average*

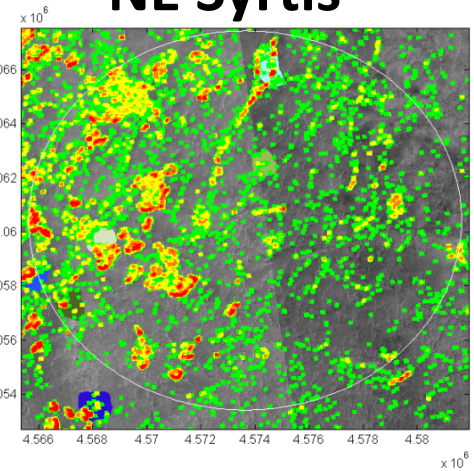
MSL

< 80 m/sol

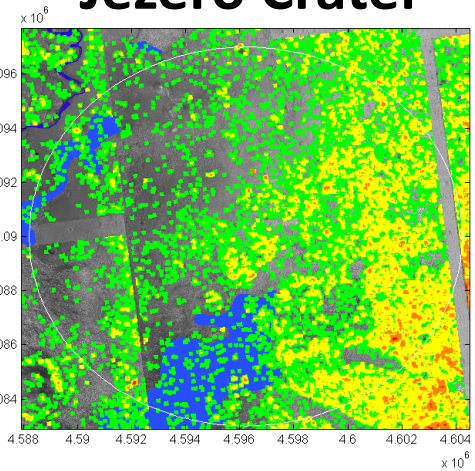
Gale Crater



NE Syrtis



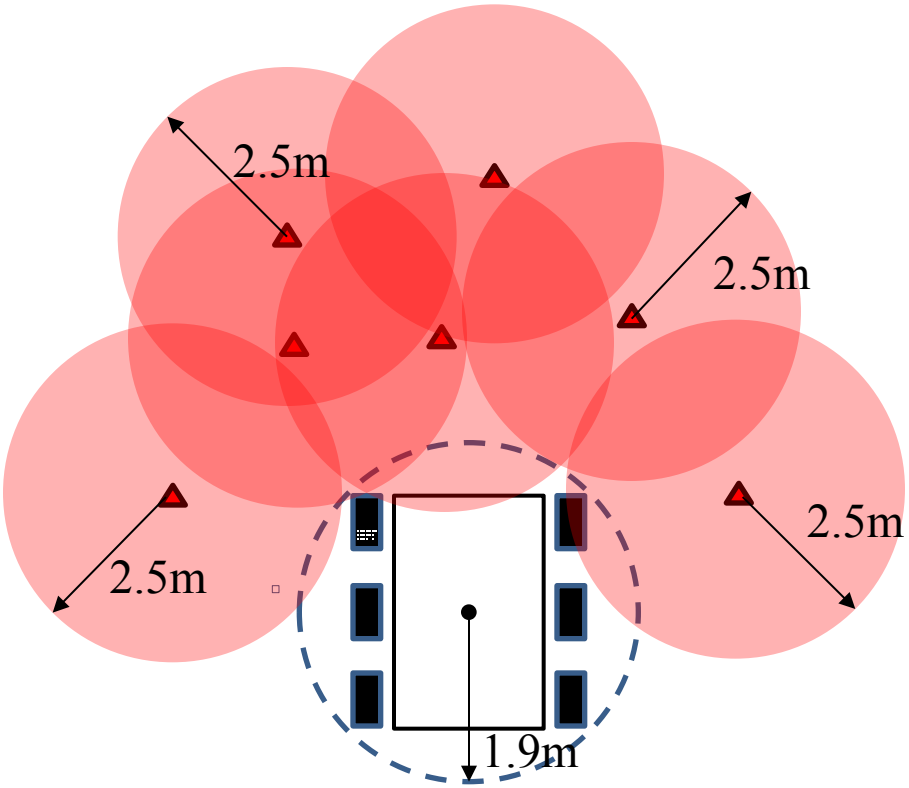
Jezero Crater



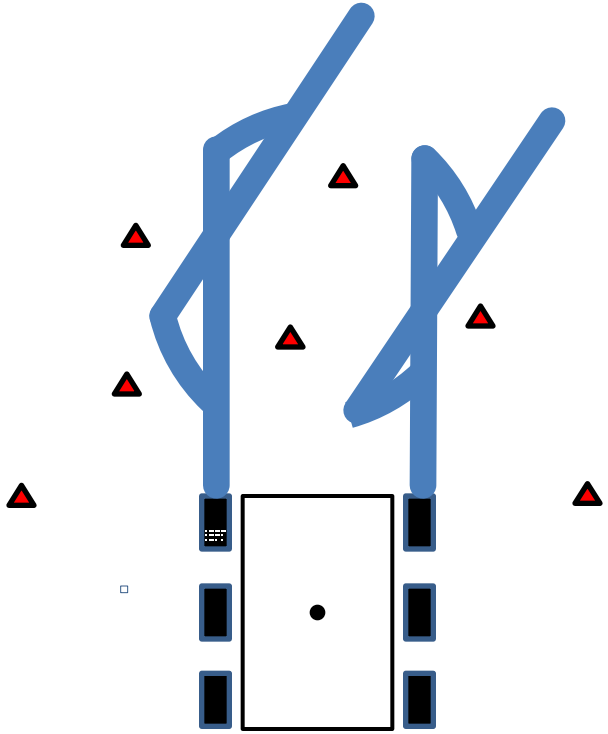
CFA: 7-10% 10-15% 15-20% >20%

Enhancement 1: Straddling

Current AutoNav



AutoNav with Straddling

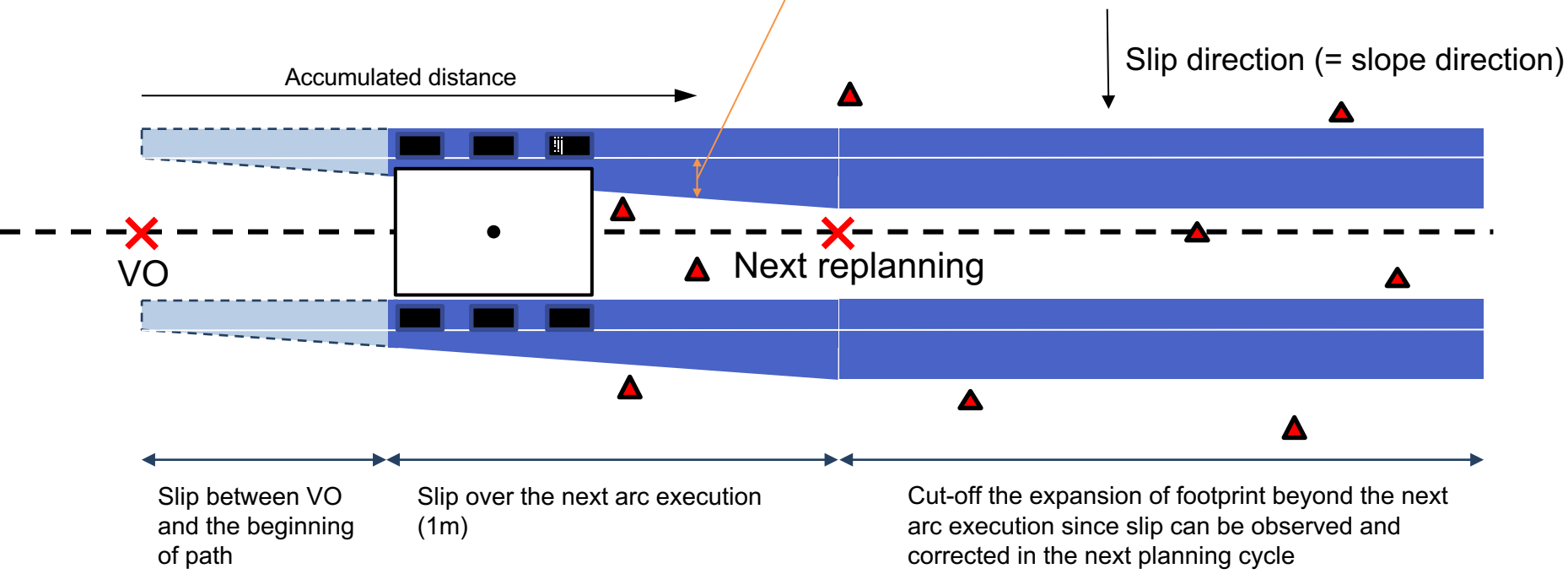


- Current AutoNav inflates obstacles by 2.5m (i.e., no straddling allowed)
- Enhanced AutoNav straddles rocks to traverse rock abundant area

Enhancement 2: Robustness to Slip

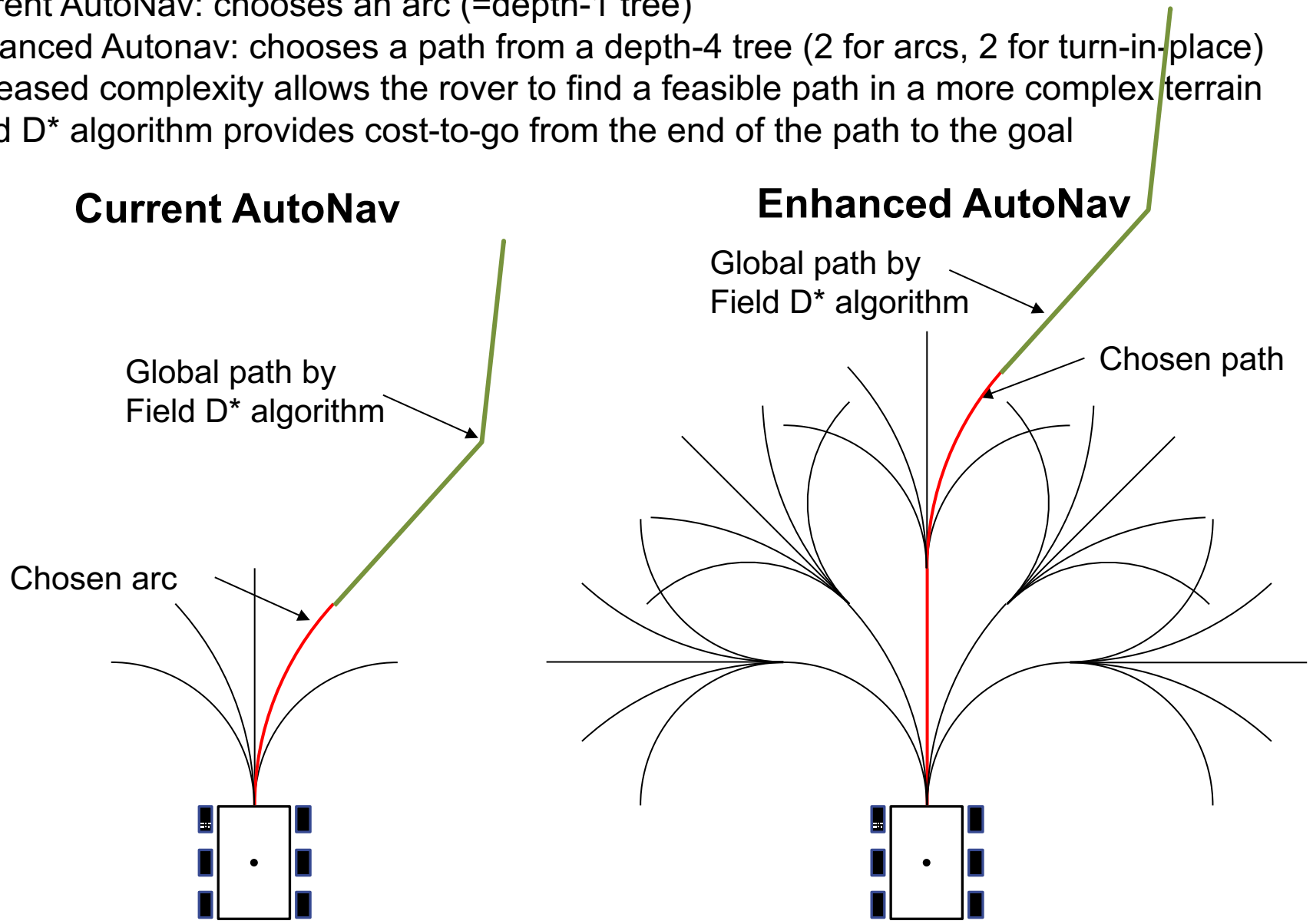
- Main idea: expand footprints to account for maximum possible slip
- Simplifying assumptions: 1) slip direction = local slope direction, 2) slip grows linearly with accumulated distance

Simple slip model: Slip = (Accumulated distance) X (slip rate)

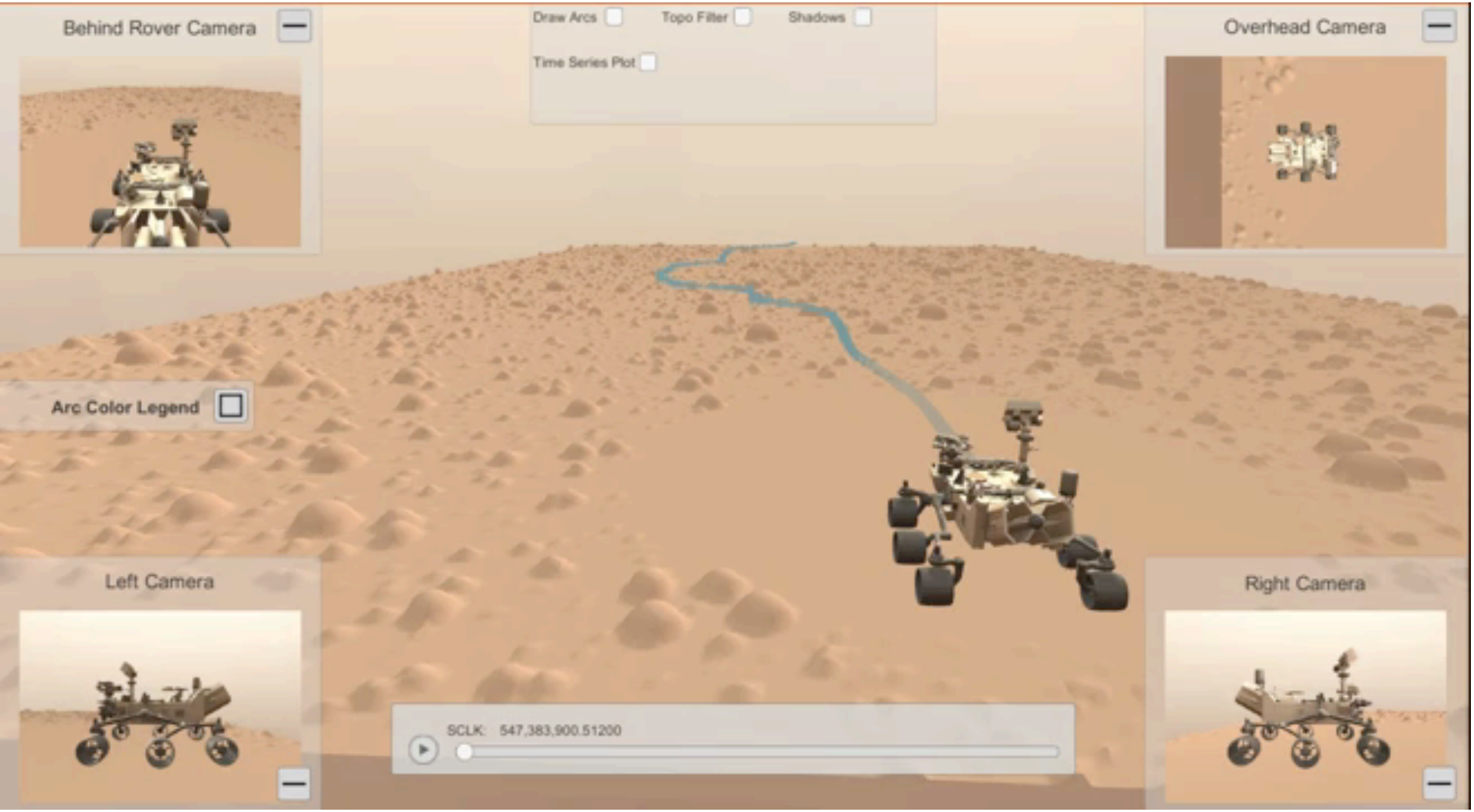


Enhancement 3: Planning with tree

- Current AutoNav: chooses an arc (=depth-1 tree)
- Enhanced Autonav: chooses a path from a depth-4 tree (2 for arcs, 2 for turn-in-place)
- Increased complexity allows the rover to find a feasible path in a more complex terrain
- Field D* algorithm provides cost-to-go from the end of the path to the goal



Enav in Simulation (Caspian)



Enav test in Mars Yard

- Using “Scarecraw” test rover